1. IN-DELTA WATER QUALITY

In-Delta Water Quality
Supporting Information

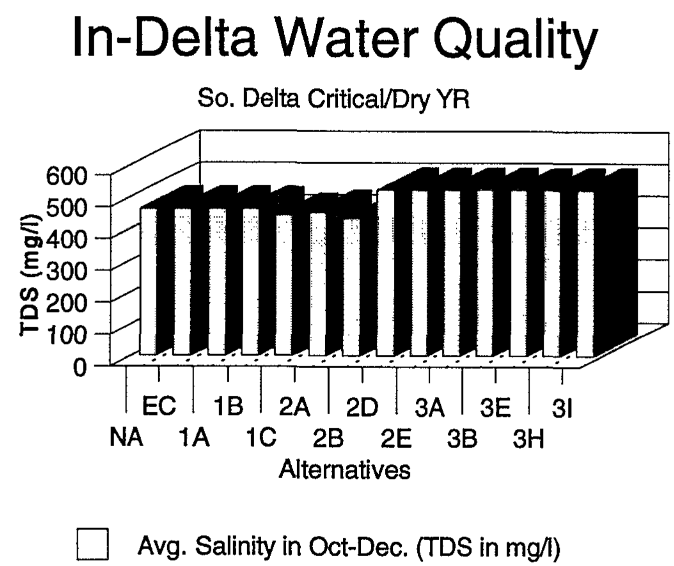
All alternatives include a program to reduce the total pollutant load entering the Delta and to manage the timing of pollutant discharges. The ecosystem and other water users will all benefit from this program. In-Delta water quality may further improve or degrade depending on the method of Delta conveyance and the water flows through the Delta. These conveyance and water flow changes primarily affect salinity levels and flow circulation, which can be used as a water quality indicator. Since all alternatives are based on operations criteria including the Delta standards, salinity levels critical to the environment will not vary significantly between alternatives. Therefore, the "In-Delta Water Quality" distinguishing characteristic does not include a measure of in-Delta ecosystem water quality. The characteristic is a measure of in-Delta water quality for those diverting and using water within the Delta.

Definition

"In-Delta Water Quality" provides a measure of **salinity** and **flow circulation** for four areas of the Delta. The measure focuses on water quality for in-Delta agricultural uses.

Summary

The western Detla salinity values vary significantly throughout the year. In general, the alternatives tend to slightly lower the salinity over the existing conditions and no-action alternative. The alternatives result in no significant change in salinity levels in the North or Central Delta. South Delta salinities increase somewhat with the alternatives, especially the alternative 3 variations. However, based on existing data, changes in salinity are relatively small. Alterantive 2 variations improve Delta circulation for water quality by providing an improved connection with the Sacramento River. Alternative 3 variations improve circulaiton by reducing reverse flow and recirculation of San Joaquin River flows. **The chart at the right provides one summary from Tables 1.1.1 thru 1.1.4. Since lower salinity is the most desirable, Table 1.1 provides a score of "5" to the lowest salinity and a score of "0" to the highest salinity.**



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1. In-Delta Water Quality

Western Delta
- Salinity (TDS)
- Flow Circulation (qualitative assessment using DSM results)

South Delta
- Salinity (TDS)
- Flow Circulation (qualitative assessment using DSM results)

Central Delta
- Salinity (TDS)
- Flow Circulation (qualitative assessment using DSM results)

North Delta
- Salinity (TDS)
- Flow Circulation (qualitative assessment using DSM results)

To Decision Matrix

Table 1.1 Summary

	Western Delta		South Delta		Central Delta		North Delta		Overall
Alternative	Salinity	Circulation	Salinity	Circulation	Salinity	Circulation	Salinity	Circulation	Score
	Slight reduction in salinity levels with the alternative 2 and 3 variations	Alternative 2 variations improve circulation with more Sacramento River flow across Delta. Alternative 3 improve circulation by reducing flow recirculation of San Joaquin River flows.	**Slight increase** in salinity levels with the alternative 2 and 3 variations	Alternative 2 variations improve circulation with more Sacramento River flow across Delta. Alternative 3 improve circulation by reducing flow recirculation of San Joaquin River flows.	Salinity levels do change enough to differentiate between alternatives. (see following tables	Alternative 2 variations improve circulation with more Sacramento River flow across Delta. Alternative 3 improve circulation by reducing flow recirculation of San Joaquin River flows.	Salinity levels do change enough to differentiate between alternatives. (see following tables	Alternative 2 variations improve circulation with more Sacramento River flow across Delta. Alternative 3 improve circulation by reducing flow recirculation of San Joaquin River flows.	
Exist. Cond.									3
No-action									2
1A									3
1B									3
1C									3
2A									4
2B									4
2D									4
2E									4
3A									3
3B									3
3E									3
3H									3
3I									3

The above summarized changes are relatively small (see following tables). Therefore all alternatives score similarly with Alternative 2 variations providing slightly better in-Delta water quality.
Lower salinity is considered better.
More Delta circulation is considered better.
Values are on a scale from 0 to 5; with 5 representing the best water quality and 0 representing the worst.

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Table 1.1.1 January-June Dry and Critical Year TDS Summary

	Jan-Mar Avg. TDS (mg/l)				Apr-Jun Avg. TDS (mg/l)			
Alternative	West	Central	South	North	West	Central	South	North
Exist. Cond.	370	200	500	110	270	120	400	100
No-action	370	200	500	110	270	120	400	100
1A	370	200	500	100	270	120	400	100
1B	370	200	500	100	270	120	400	100
1C	370	200	510	100	280	130	370	100
2A	240	120	510	100	240	120	380	100
2B	240	120	510	100	240	120	380	100
2D	230	120	510	100	230	120	430	100
2E	220	120	510	100	220	120	420	110
3A	250	220	510	100	220	180	420	110
3B	250	220	510	100	220	180	420	110
3E	290	260	510	100	220	220	480	110
3H	250	220	510	100	210	180	450	110
3I	290	260	510	100	220	220	480	110

Table 1.1.2 July-December Dry and Critical Year TDS Summary

	Jul-Sept Avg. TDS (mg/l)				Oct-Dec Avg. TDS (mg/l)			
Alternative	West	Central	South	North	West	Central	South	North
Exist. Cond.	1200	250	450	140	1170	280	460	130
No-action	1200	250	450	140	1170	280	460	130
1A	1200	250	450	140	1170	280	460	130
1B	1200	250	450	140	1170	280	460	130
1C	1200	250	460	140	1150	260	440	130
2A	1080	150	460	160	900	140	450	150
2B	1080	150	460	160	890	130	430	150
2D	1010	150	470	160	840	130	520	150
2E	930	140	470	160	770	130	520	130
3A	1080	170	470	160	1000	200	520	140
3B	1060	170	470	160	980	200	520	140
3E	1050	170	470	160	960	250	520	150
3H	1000	170	470	160	900	200	520	140
3I	1050	170	470	160	960	250	520	150

Table 1.1.3 January-June All Year TDS Summary

	Jan-Mar Avg. TDS (mg/l)				Apr-Jun Av. TDS (mg/l)			
Alternative	West	Central	South	North	West	Central	South	North
Exist. Cond.	270	180	360	110	210	120	310	100
No-action	270	180	360	110	210	120	310	100
1A	270	180	360	110	210	120	310	100
1B	270	180	360	110	210	120	310	100
1C	270	180	360	110	210	130	300	100
2A	200	130	360	110	180	120	310	100
2B	190	130	360	110	180	120	310	100
2D	180	120	360	110	180	120	340	100
2E	180	120	360	110	180	120	340	100
3A	220	200	360	110	180	150	350	100
3B	220	200	360	110	180	150	350	100
3E	230	230	360	110	180	190	380	100
3H	220	200	360	110	180	150	350	100
3I	230	230	360	110	180	190	380	100

Table 1.1.4 July-September All Year TDS Summary

	Jul-Sept Avg. TDS (mg/l)				Oct-Dec Avg. TDS (mg/l)			
Alternative	West	Central	South	North	West	Central	South	North
Exist. Cond.	900	210	410	120	980	260	420	120
No-action	900	210	410	120	980	260	420	120
1A	900	210	410	120	980	260	420	120
1B	900	210	420	120	980	250	410	120
1C	890	210	430	120	970	240	400	120
2A	780	130	430	140	730	130	390	140
2B	780	130	430	140	730	130	390	140
2D	730	130	430	140	700	130	470	140
2E	670	130	430	140	640	130	470	130
3A	750	150	430	140	760	220	450	130
3B	750	150	430	140	760	220	450	130
3E	770	160	430	140	800	240	470	140
3H	750	150	430	140	720	220	470	130
3I	770	160	430	140	800	240	470	140

Delta flow circulation can provide an indication of water quality with following considerations:
- Stagnation in the Delta interior can result in poorer water quality (local discharges make this situation worse)
- Recirculation of San Joaquin River flows down the DMC results in poorer water quality with return flows
- Reverse flow in Western Delta tends to pull in salinity
- Connection to Sacramento River tends to pull better water into the central Delta (cfs Georgiana, North & South forks of Mokelumne

Alternative	Delta Inflows	Exports	Stagnation	Recirculation	Reverse Flow	Connect to Sac (cfs)	Remarks
1A	High	High	0	Very high	0	7800	Alternative 2 variations provide more connection to the fresher Sacramento River Flows. Alternative 3 variations significantly reduce recirculation of San Joaquin
1C	High	High	0	Very high	0	7800	
2B	High	High	0	Very high	0	16100	
2D	High	High	0	Very high	0	16000	
2E	High	High	0	Very high	0	23000	
3E	High	High	Some	Low	0	6700	
1A	Medium	Low	0	Very high	0	3600	Alternative 2 variations provide more connection to the fresher Sacramento River Flows. Alternative 3 variations significantly reduce recirculation of San Joaquin
1C	Medium	Low	Some	High	0	3600	
2B	Medium	Low	Some	High	0	8300	
2D	Medium	Low	Some	High	0	8100	
2E	Medium	Low	Some	High	0	11200	
3E	Medium	Low	Some	Low	0	2900	
1A	Low	High	0	Very High	High	6100	Low inflow and high export is an infrequent occurrence; therefore, discount this condition for all
1C	Low	High	Some	High	High	6100	
2B	Low	High	Some	High	Some	9800	
2D	Low	High	Some	High	Some	9800	
2E	Low	High	Some	High	Some	9200	
3E	Low	High	Some	Moderate	0	1400	
1A	Low	Low	0	High	0	4500	Little distinction between alternative variations with low inflow and low export
1C	Low	Low	Some	High	0	4500	
2B	Low	Low	Some	High	0	4900	
2D	Low	Low	0	High	Some	5200	
2E	Low	Low	0	High	Some	5500	
3E	Low	Low	0	High	0	4000	

Supporting Information for Table 1.1

In-Delta water quality will vary with the storage and conveyance facilities. Preliminary Delta Simulation Model (DSM) runs provide an indication of in-Delta water quality for the various alternatives. These runs provide an initial evaluation of flow, circulation, and salinity as total dissolved solids (TDS) contained in *Status Reports on Technical Studies for the Storage and Conveyance Refinement Process, Delta Simulation Model Studies of Alternatives 1A, 1C, 2B, 2D, 2E, 3E, August 4, 1997.* Simulations were conducted for the hydrologic simulation period 1976-1991. TDS predictions were presented for mean monthly tidally-averaged values over the hydrologic period. Since the DSM model is not yet linked with DWRSIM, the evaluations consider only at the change due to Delta conveyance. Future runs will also include TDS changes due to the different hydrology between the alternatives. ***This provisional data supporting Table 1.1 and supporting tables tend to over estimate the TDS concentrations. These will be revised in future model runs.***

Total dissolved solids (mg/l) estimates are summarized separately for each quarter of the year; first quarter (January, February, March); second quarter (April, May, June,); third quarter (July, August, September); and fourth quarter (October, Novemeber, December). This data is summarized or all 16 years of the simulation and for the dry and critical year types. The average of TDS at Emmaton and Jersey was used for the **Western Delta**. The average of Old River at Middle River, Old River at Tracy Road, and San Joaquin River at Brandt Bridge was used for the **Southern Delta**. The average of San Andreas Landing, Terminous, Prisoner's Point, and Old River at Rock Slough was used for the **Central Delta**. The average of Rio Vista and Green's Landing was used for the **Northen Delta.**

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Average salinity estimates by quarter for dry/critical year types are shown in Tables 1.1.1 and 1.1.2. Average salinity estimates by quarter for all year types are showm in Tables 1.1.3 and 1.1.4. The provisional salinity data for the 6 modeled alternatives are shown in **bold** numbers in the tables. Salinity values for the other alternatives were estimated based on professional judgement and the modeled data and are shown as smaller fonts in the tables.

Western Delta Salinity

Current estimates of west-Delta water quality show that during summer months (July through September) salinity levels of source water can be as high as 1200 ppm. During this period, some late season field crops, such as corn or some vegetables, may be receiving final irrigations. The CALFED alternatives potentially improve the salinity of the source water by as much as 200 ppm. This can be beneficial to growers in the western-Delta who may be able to take advantage of the slightly improved quality for production of late season crops.

Reduced salinity of the source water can also reduce the amount of water applied to fields. This is a direct result of decreased leaching requirements. Benefits in the form of reduced agricultural drainage may also occur, since less leaching translates to less drainage needing to be pumped back off the island.

To the extent that high salinity in the summer months has discouraged planting of some crops types or varieties, improved salinity levels may result in slight shifts in cropping patterns. For instance, early maturing grain crops may be replaced by corn or other moderately salt tolerant row crops. However, the any shift in cropping resulting from water quality improvements is expected to be minor.

Southern Delta Salinity

The salinity levels estimated to occur as a result of a the various CALFED alternatives are not anticipated to create adverse impacts for local Delta agricultural uses. As shown on the table, south-Delta water quality ranges by alternative, but generally results in similar salinity levels in comparison to existing conditions. The exception, however, is for a few alternatives during the spring (April through June) and fall (October through December) months. In the spring, existing salinity is 400 ppm. This rises to as much as 480 ppm under alternatives 3E and 3I. In the fall, existing salinity levels of 460 ppm are shown to possibly increase to as much as 520 ppm. (Is this a major concern to south-Delta agricultural interests?)

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Typically, salinity levels that exceed 450 to 500 ppm can begin to have a yield reducing impact on some of the more salt sensitive irrigated crops. However, when salts are adequately leached out of the rootzone, this impact is minimize or even non-existent. In the Delta, water supplies are ample, though maybe of undesirable stage or quality, and water is available for adequate leaching to counter-effect the potential impact of slightly higher saline water. Moreover, when the conditions in the south-Delta for the spring are compared with the existing conditions for the summer months (July through September), the increased salinity of the spring months seems to become less of an issue. However, it is in the spring, when planting and germination generally occur, that salinity can potentially have a negative impact on more salt sensitive crops.

Generally, it is anticipated that sufficient quantities of water will be available in adjacent channels and sloughs to the south-Delta irrigators such that any possible adverse impact from slightly increased salinity levels will be minimized through minor additional

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leaching. It is understood that to obtain additional leaching, more water may have to be pumped onto and off of Delta islands. To the extent that the minor shifts in salinity drive a need for additional leaching, there will be an associated increase in pumping costs.

Central Delta Salinity

Central Delta salinity levels are generally lower with the alternative 2 variations. However, the salinity levels (generally less than 250 mg/l) is good for all alternatives and therefore does not distinguish between alternatives.

Northern Delta Salinity

The Northern Detla salinity (generally less than 200 mg/l) levels is good for all alternatives and therefore does not differentiate between alternatives.

Delta Circulation

Rankings in Table 1.1 for Delta circulation were estimated from the circulation vectors in the previously mentioned report. In general, circulation was improved the most with the alternative 2 variations. The alternative 3 variations generally improved Delta circulation over that with existing channels. The alternative 3 variations generally did not have Delta circulation comparable with the alternative 2 variations due flow in the isolated facility and resultant reduced Delta flow. These are vary preliminary assessments since the detailed modeling work is continuing.

These evaluations of in-Delta water quality will come from the impact analysis for the EIR/EIS and from workgroups of experts. Since development of this information is in progress, the following is a sample of the types of information that may ultimately support Table 1.1.

Information in Table 1.1 and this supporting information will be updated as more detailed modeling becomes available.

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Figure

Output Locations for End of Month Salinity